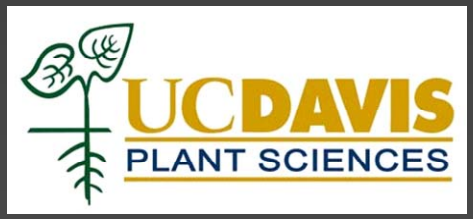
Method to Reduce Fumigant Volatilization Losses from Drip-Fumigated Fields

Husein Ajwa

University of California - Davis



Research Team

Shachar Shem-Tov, UC Davis

Wonssok Ha, UC Davis

Suduan Gao, USDA-ARS

David Sullivan, Sullivan Environmental

Randy Segawa and Pam Wofford, CDPR

Deb Shatley, Dow AgroSciences

Research was funded by the California Strawberry Commission

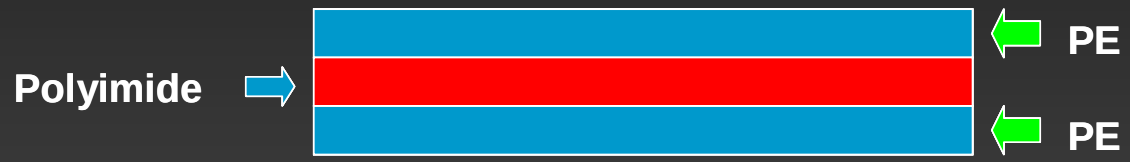
Need for Research to Reduce Fumigant Volatilization Losses from Strawberry Fields

- Fumigant reregistration process and new risk assessment (cluster analysis) will impose larger buffer zones and lower chloropicrin application rates.
- Many Townships exceeded the Telone Cap (90,250 “adj” lbs per township).
- New regulations were imposed by the USEPA to reduce VOC emissions in California (Ventura County and the SJV).

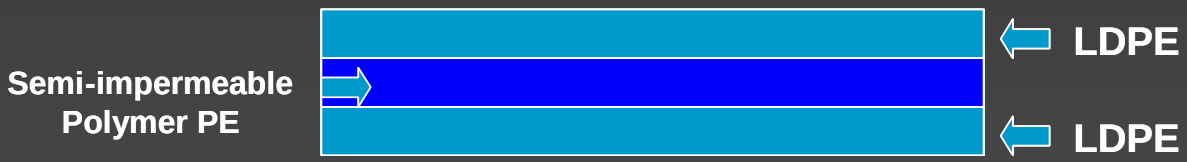
CALIFORNIA STRAWBERRY COMMISSION
GET THE RED EDGE!

Reduction of Fumigant Volatilization Losses in Strawberry Raised Beds after Drip Fumigation with InLine or Pic

- **Virtually Impermeable Film (VIF)**



- **Semi-Impermeable Film**



- **Application of Thiosulfate/Water seal**

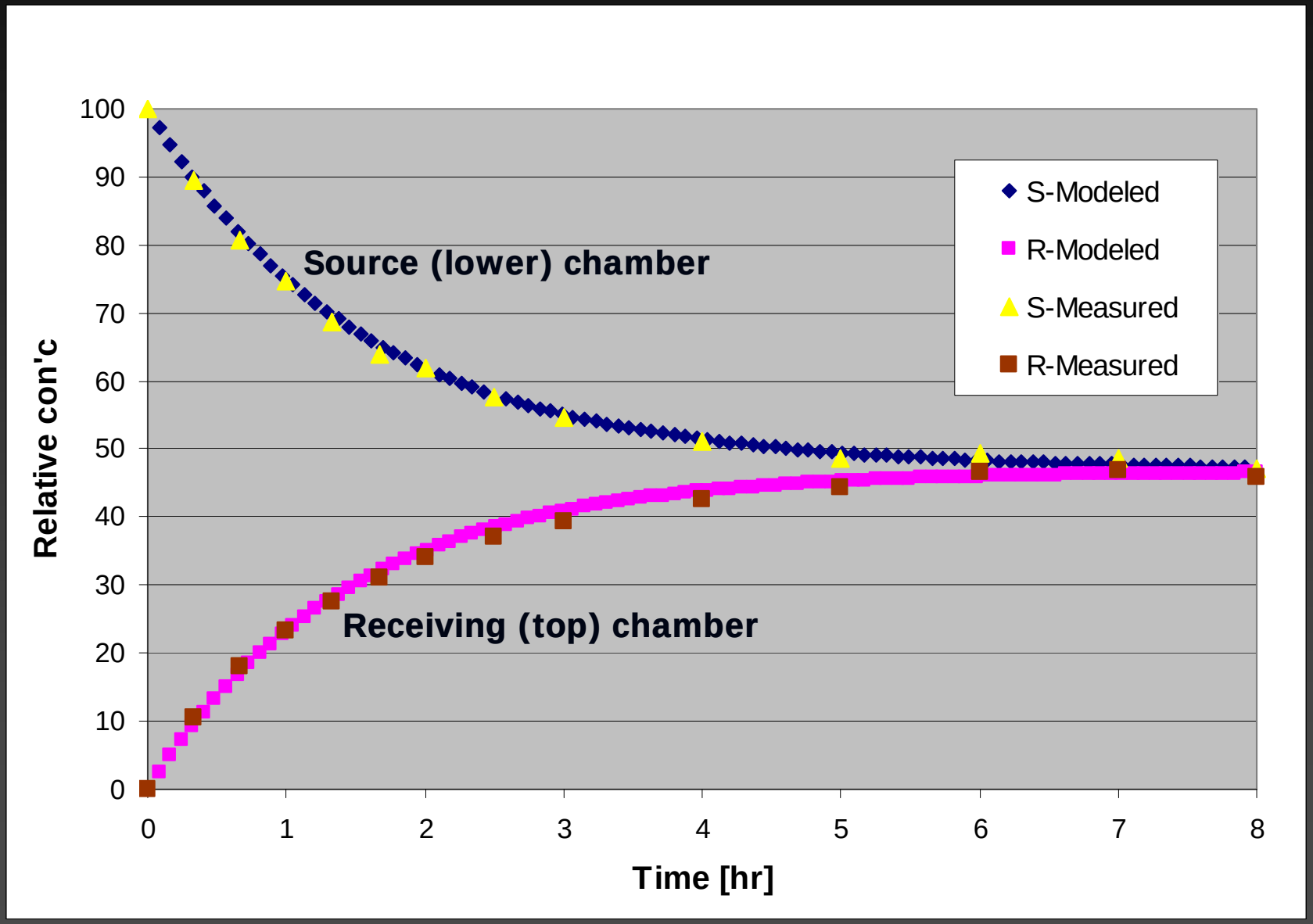
Laboratory Method to Evaluate Plastic Permeability

- Plastic film is mounted between two chambers.
- Fumigant is applied to the lower chamber.

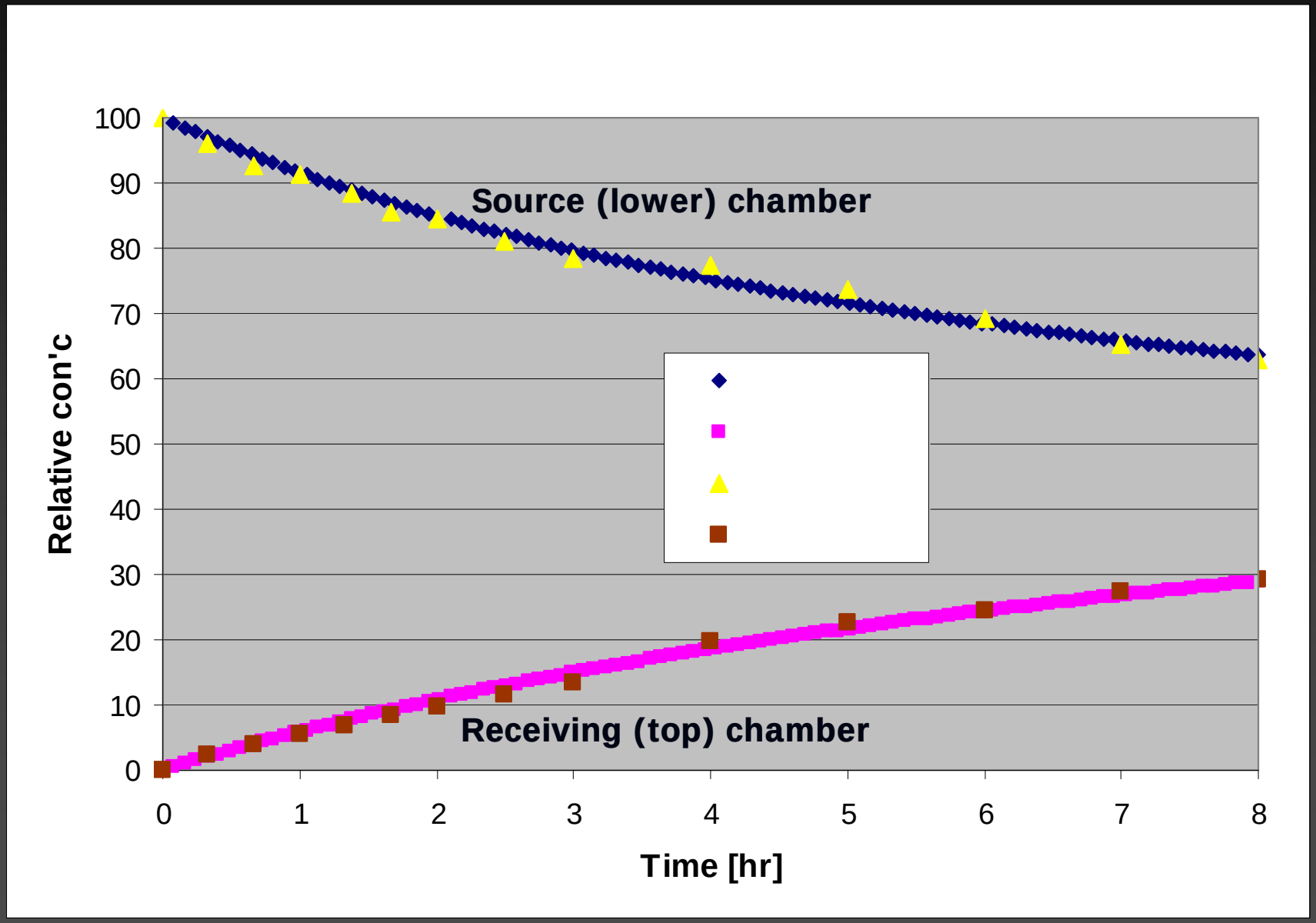
Laboratory Method to Evaluate Plastic Permeability

- Fumigant is measured by GC in both chambers.
- The Mass Transfer Coefficient (MTC) is calculated.

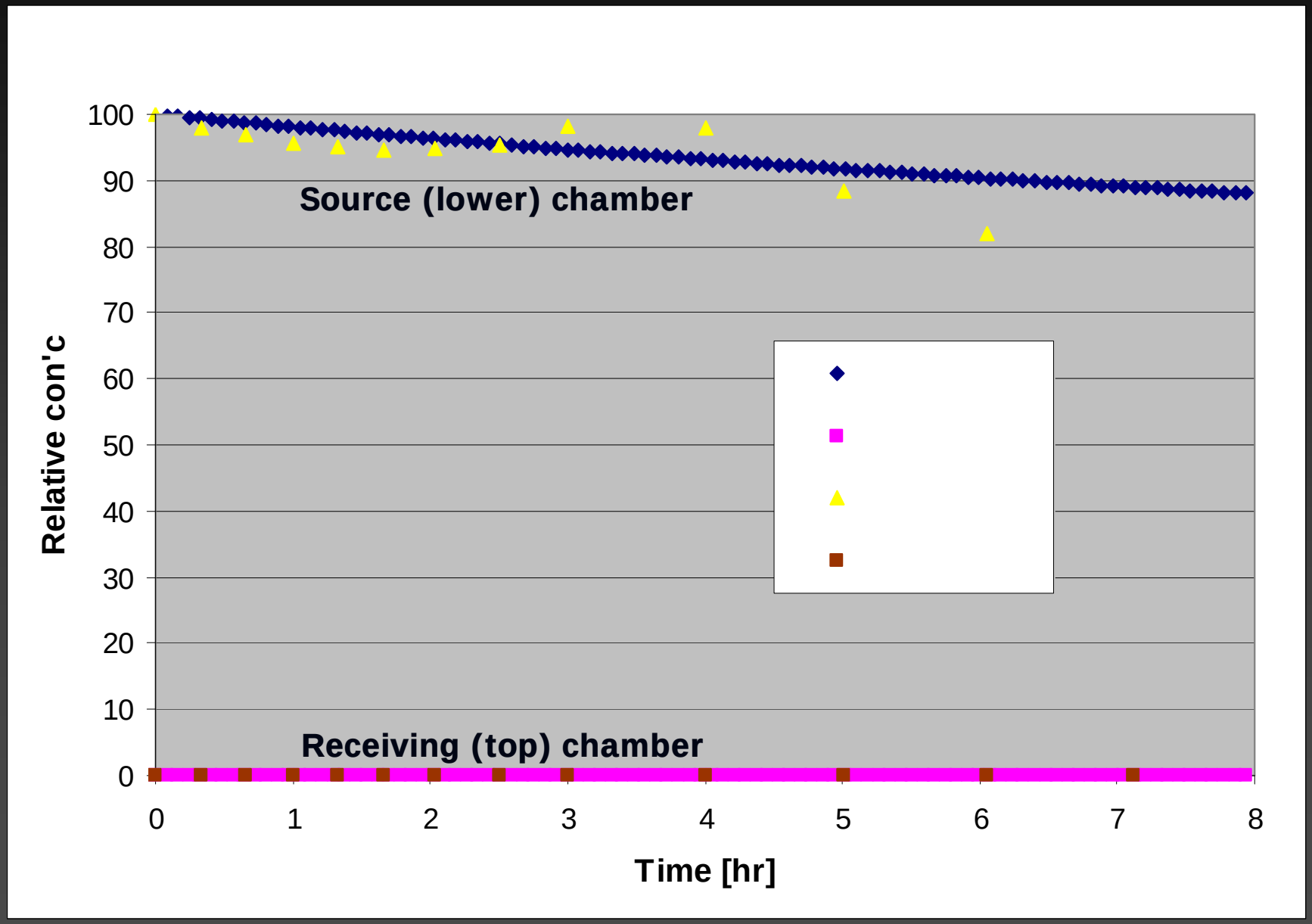
Diffusion of MB through standard LDPE



Diffusion of MB through metalized “shiny” film



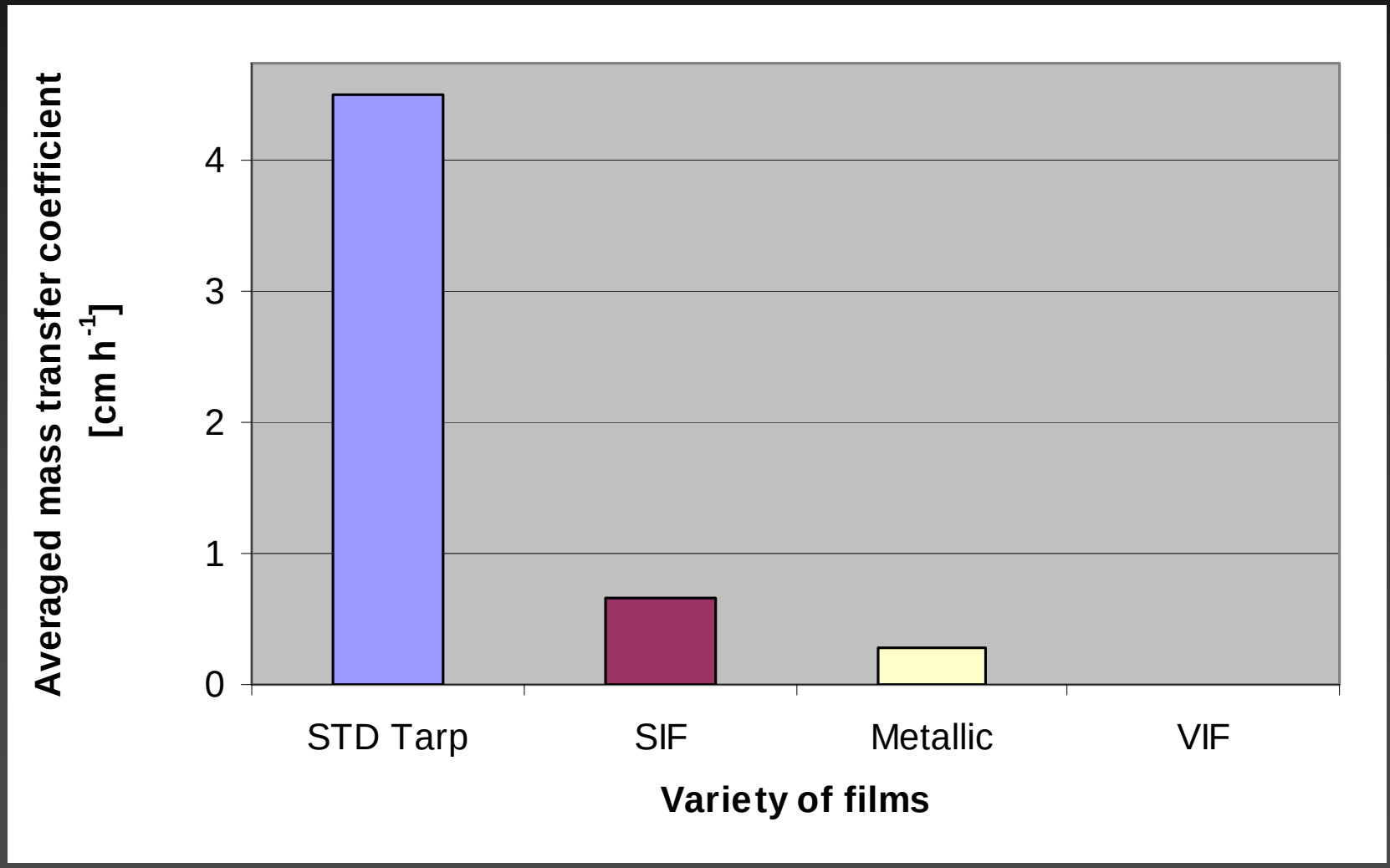
Diffusion of MB through Bromostop VIF



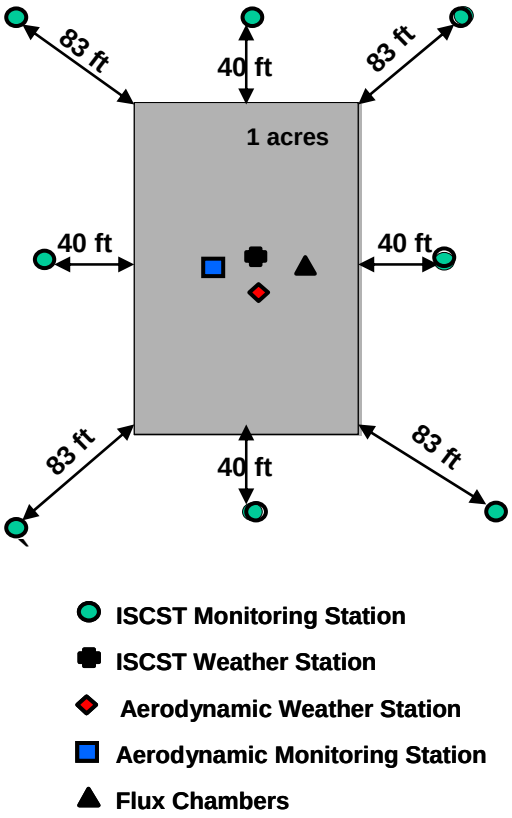
Mass Transfer Coefficient Results

Film type	MB	IM	Cis 1,3-D	Trans 1,3-D	CP
Bromostop black VIF	< 0.001	< 0.001	0.012	0.079	< 0.001
PolyPak SIF (2.0 mil)	0.67	0.39	3.15	4.01	1.19
Metalized (1.3 mil)	0.29	0.47	6.70	7.77	3.30
Standard LDPE (1.25 mil)	4.50	2.60	15.8	16.2	11.0

Methyl Bromide Mass Transfer Coefficient under Laboratory Conditions

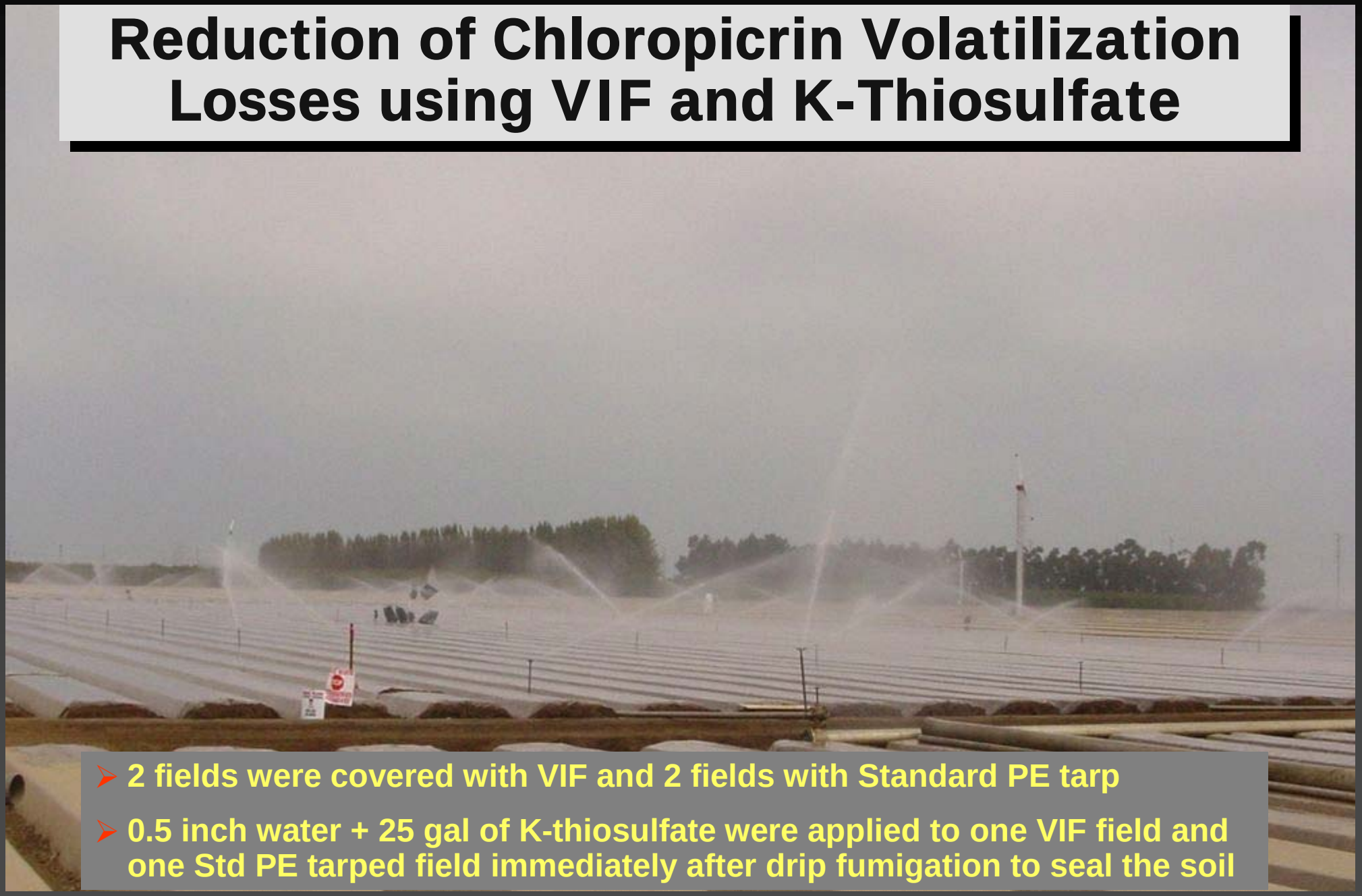


Large scale studies on using VIF for fumigant emission reduction

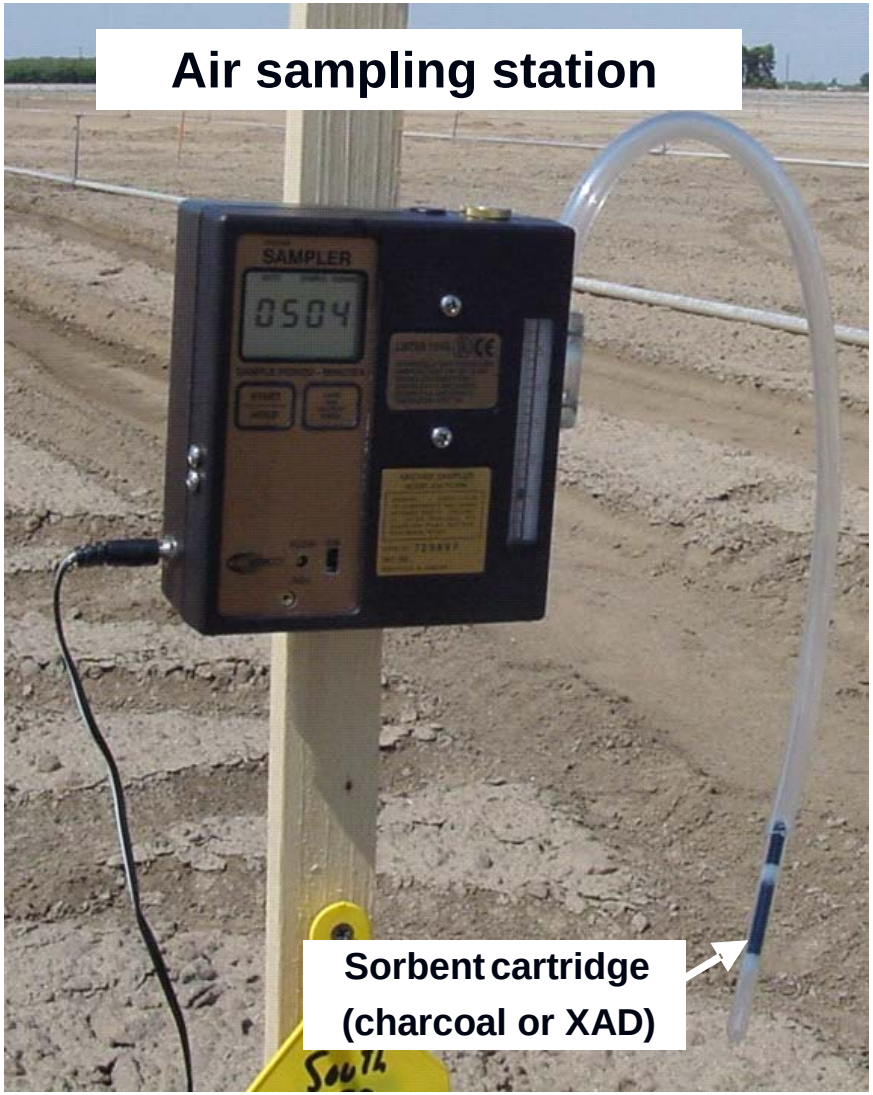


Large scale studies on using VIF & SIF for fumigant emission reduction

Reduction of Chloropicrin Volatilization Losses using VIF and K-Thiosulfate



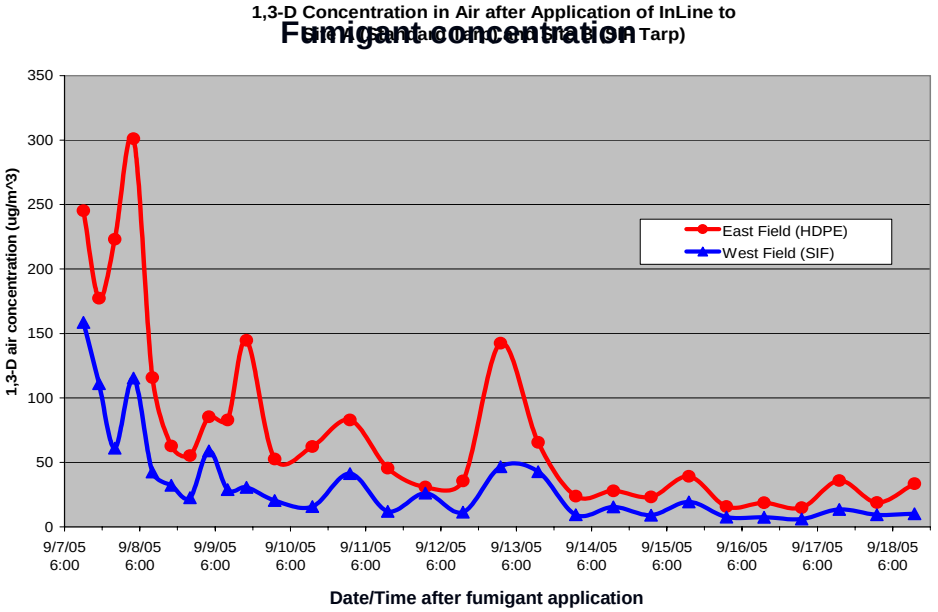
- 2 fields were covered with VIF and 2 fields with Standard PE tarp
- 0.5 inch water + 25 gal of K-thiosulfate were applied to one VIF field and one Std PE tarped field immediately after drip fumigation to seal the soil

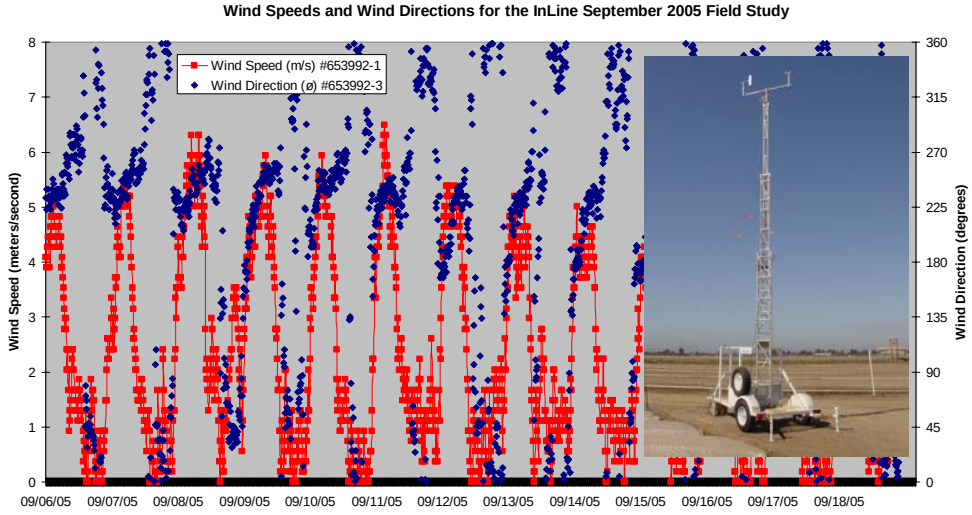


Air around each field was continuously sampled by using sorbent tubes (cartridges) attached to air pumps at 6 feet above ground. Tubes were replaced every 6 or 12 hours and analyzed by gas chromatography.

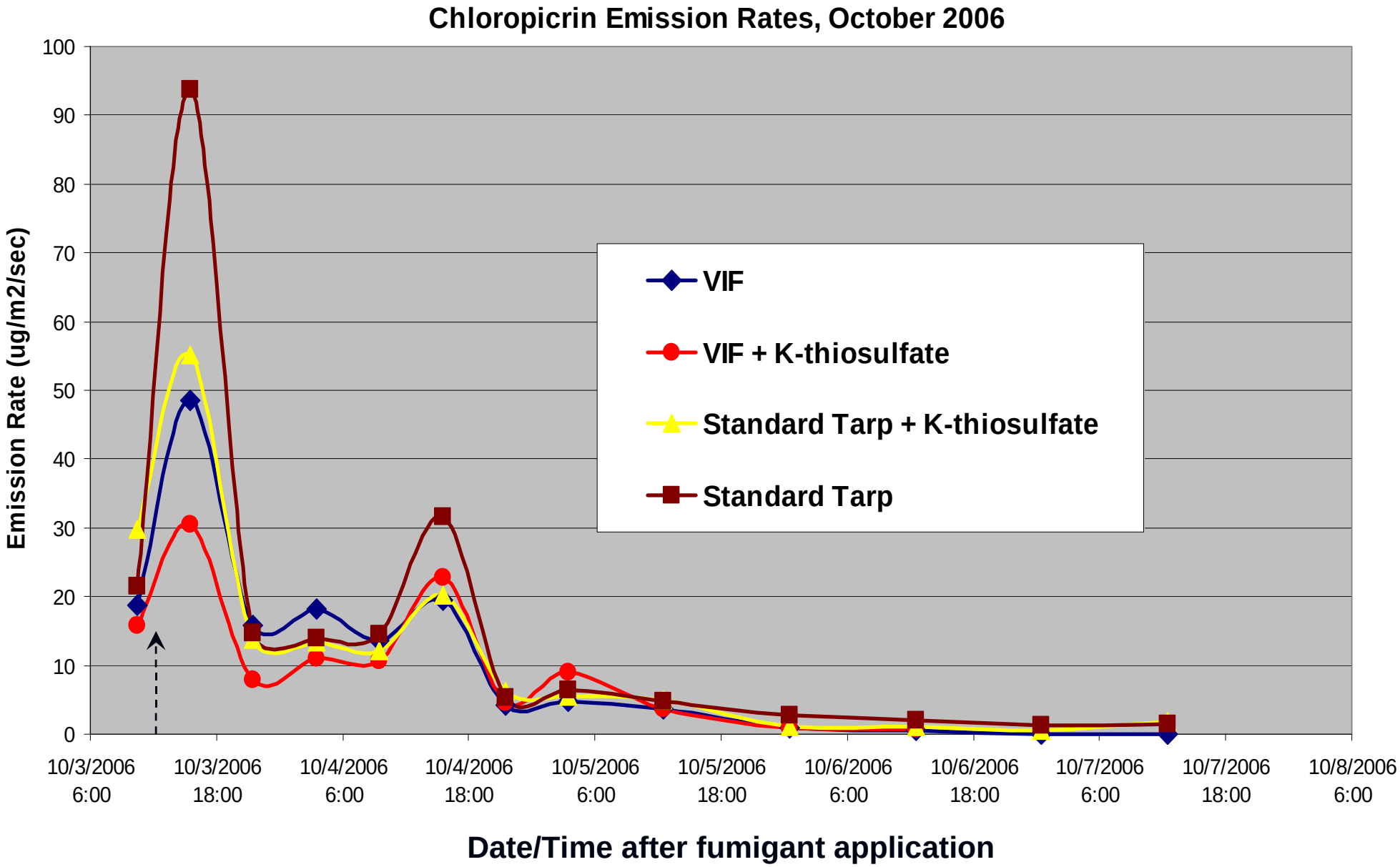
Calculating emission rates by the Industrial Source Complex Short Term dispersion model (ISCT3).

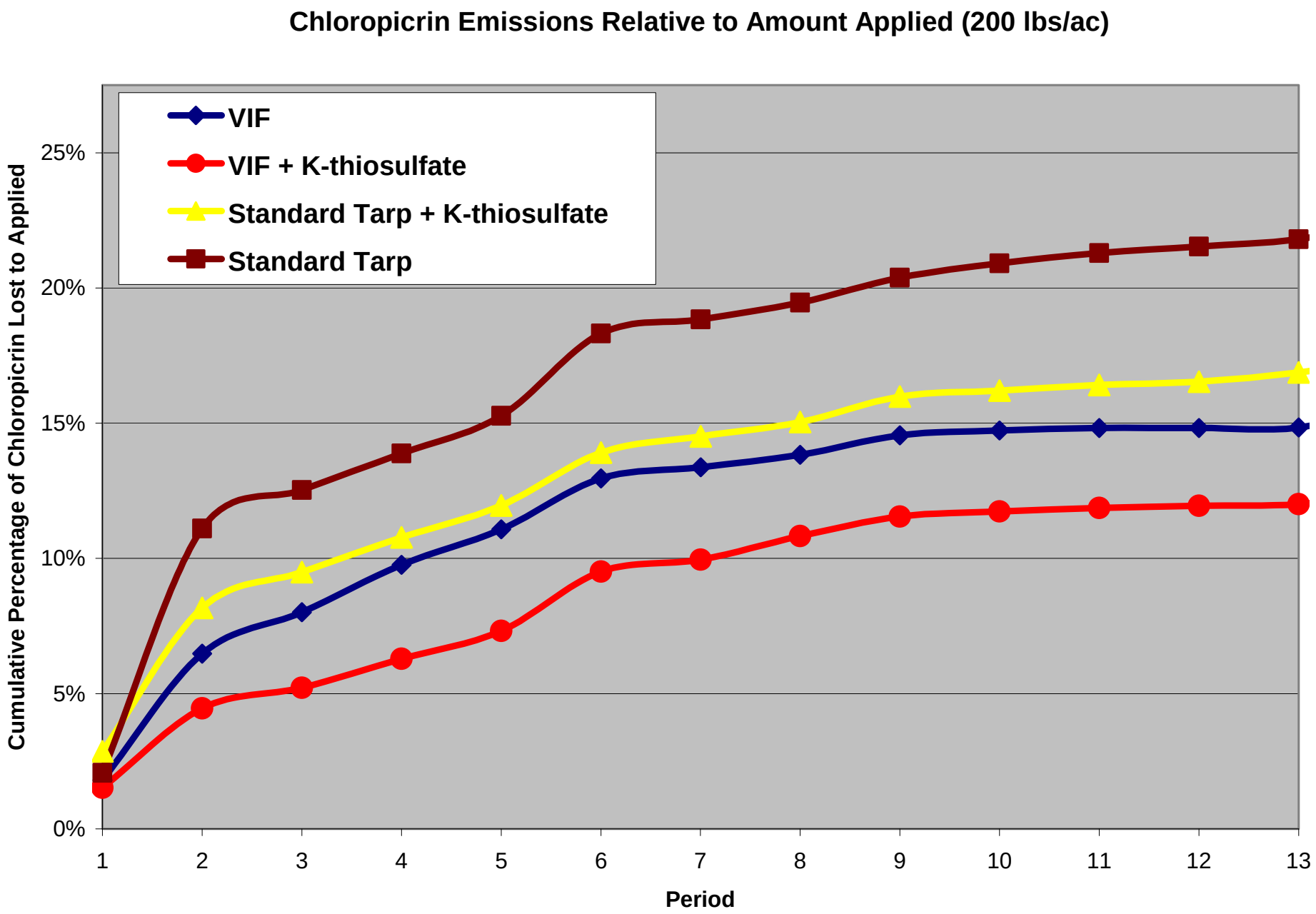
Measured concentrations around the field and meteorological data (wind speed and direction, air temperature, solar radiation, etc.) were used to back-calculate fumigant emission rates (g m^{-2} sec^{-1}) by using the ISCT3-USEPA model.





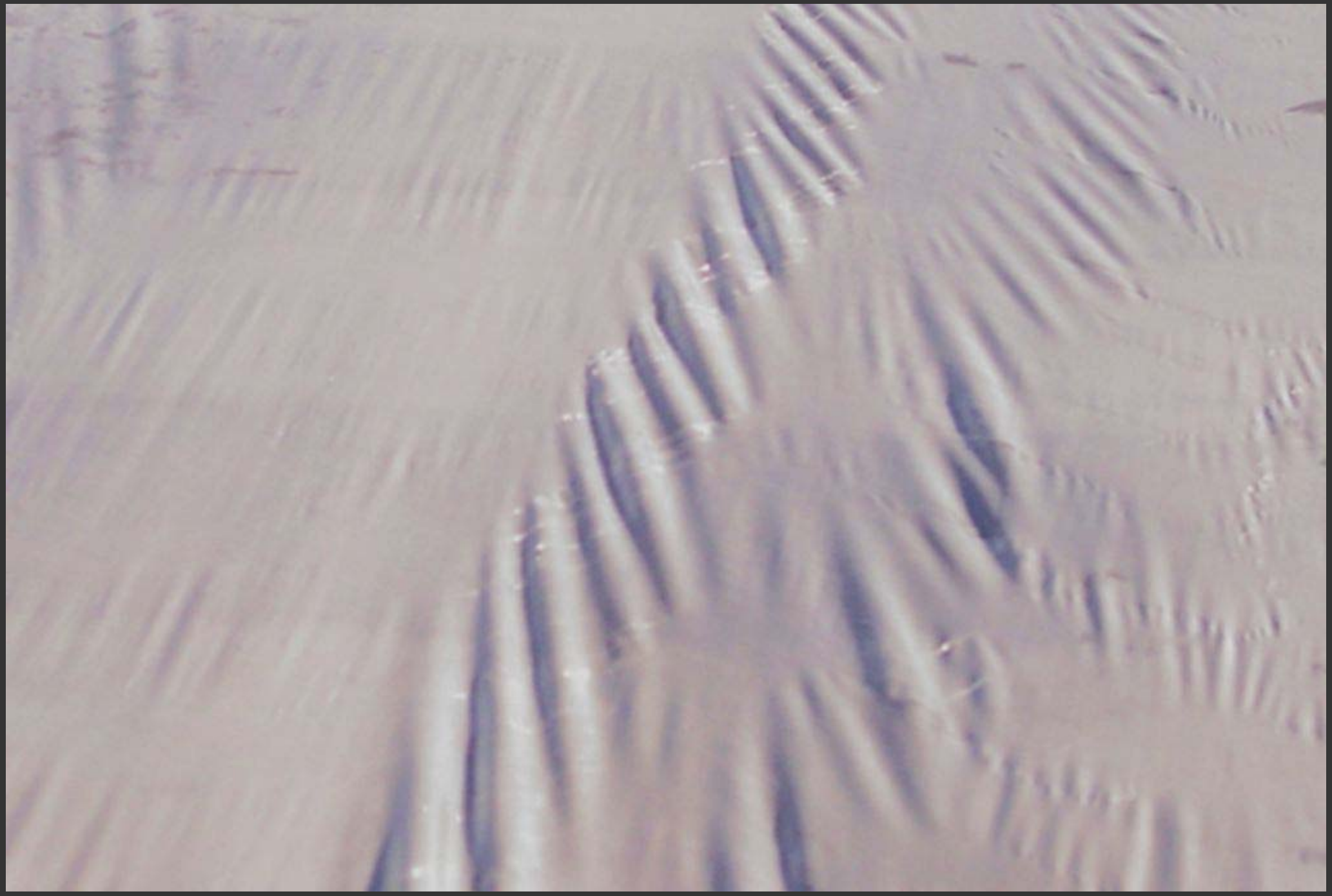
Wind speed & direction


Chloropicrin Emission Rates, October 2006
Emission Rate (ug/m2/sec)
100
90
80
70
60
50
40
30
20
10
0
VIF
VIF + K-thiosulfate
Standard Tarp + K-thiosulfate
Standard Tarp
10/3/2006 6:00
10/3/2006 18:00
10/4/2006 6:00
10/4/2006 18:00
10/5/2006 6:00
10/5/2006 18:00
10/6/2006 6:00
10/6/2006 18:00
10/7/2006 6:00
10/7/2006 18:00
10/8/2006 6:00
Date/Time after fumigant application


Chloropicrin Emissions Relative to Amount Applied (200 lbs/ac)
VIF
VIF + K-thiosulfate
Standard Tarp + K-thiosulfate
Standard Tarp
Cumulative Percentage of Chloropicrin Lost to Applied
25%
20%
15%
10%
5%
0%
1
2
3
4
5
6
7
8
9
10
11
12
13
Period

VIF SUMMARY

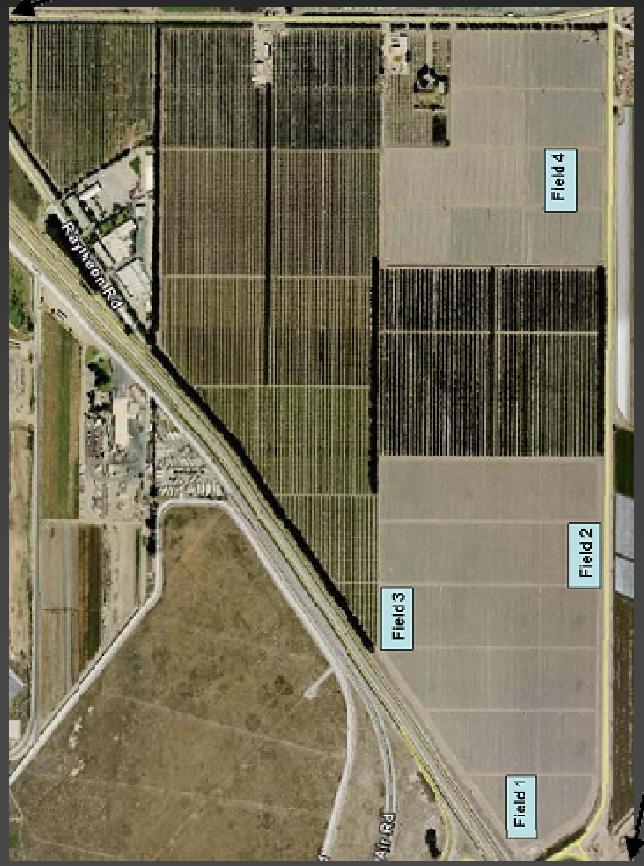
- VIF reduced early emissions rate by 50% relative to 1.5 mil standard tarp.
- Chloropicrin cumulative emissions from fields covered with VIF was ~50% relative to fields covered with 1.5 mil standard tarp.
- K-thiosulafte water seal reduced emissions by ~50%.
- Issues related to VIF:
  - Availability, Price, stretching, gluing, etc.

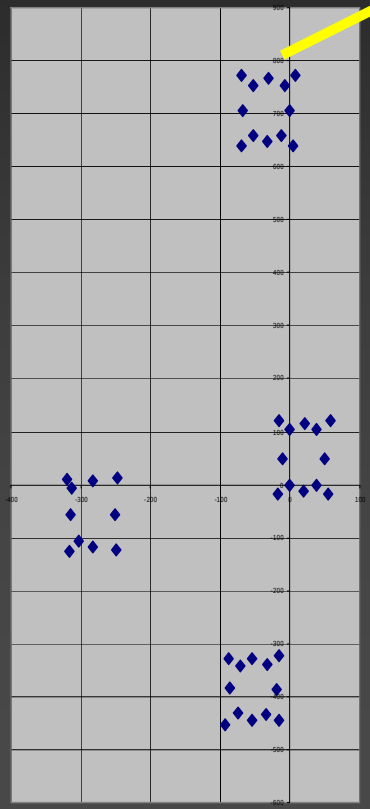


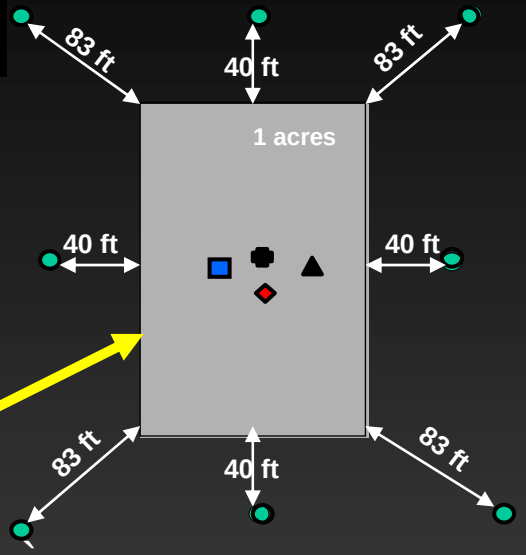
No suitable glue is available for VIF

Wind can blow away the tarp

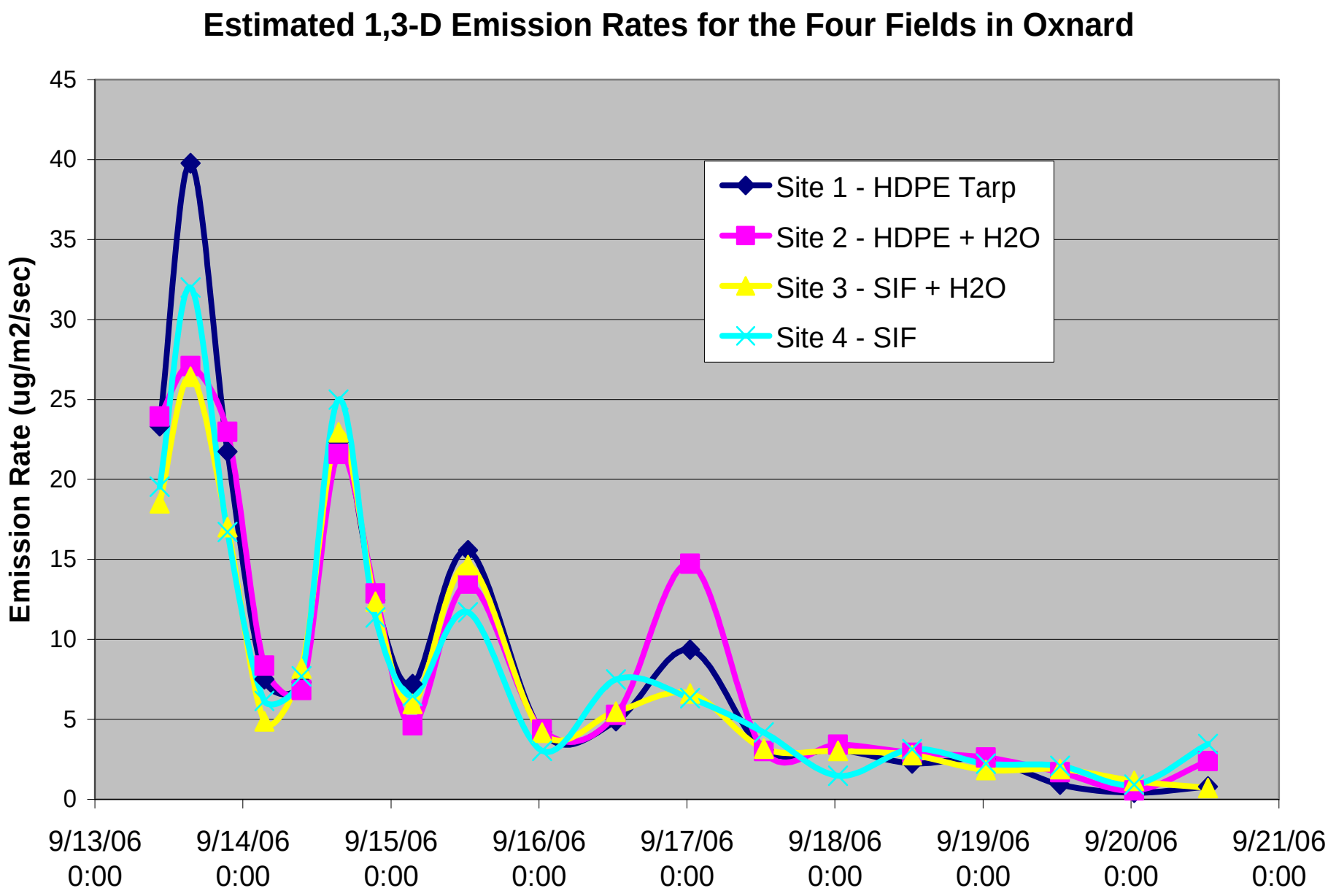
Large scale studies on using SIF for fumigant emission reduction

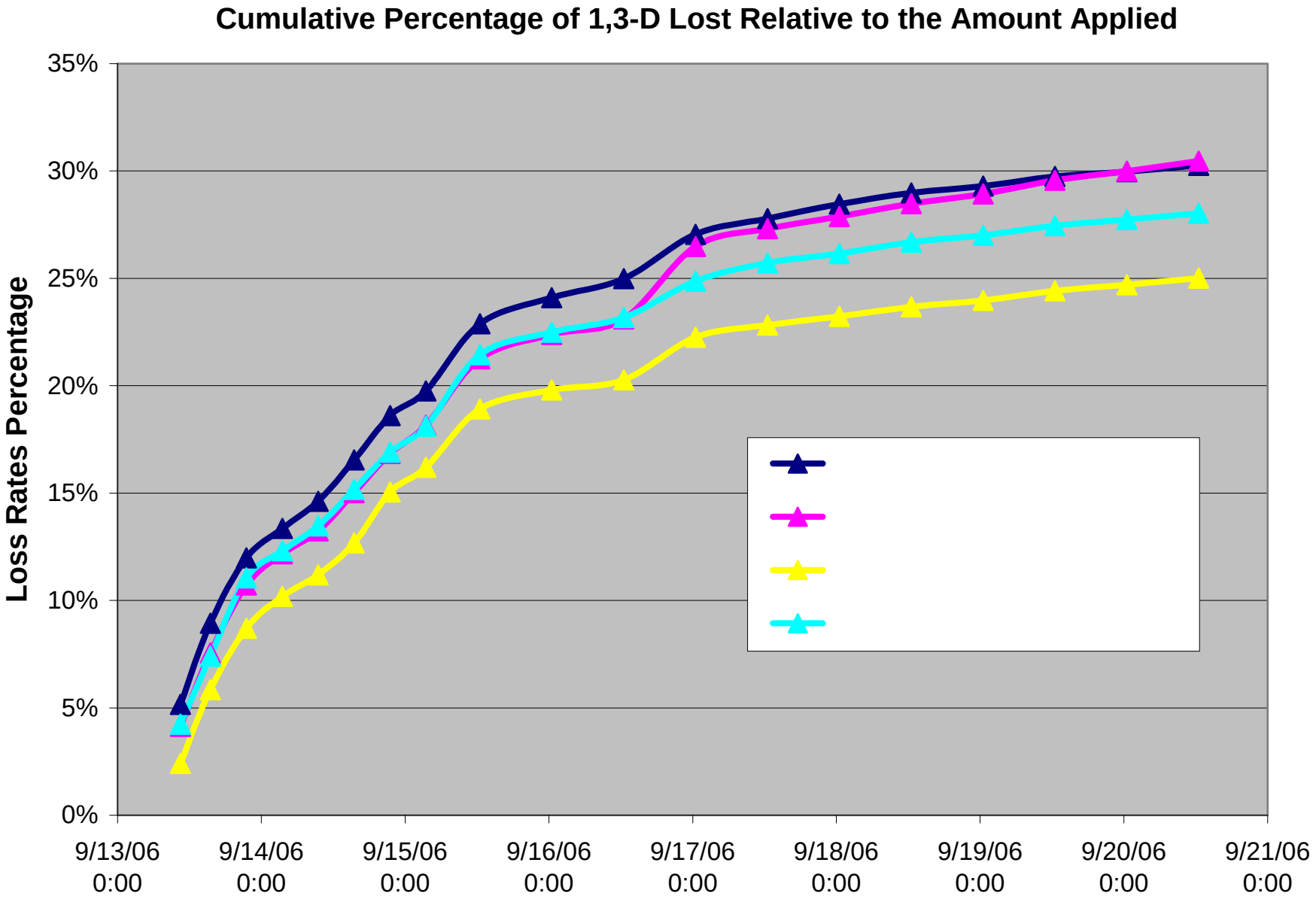




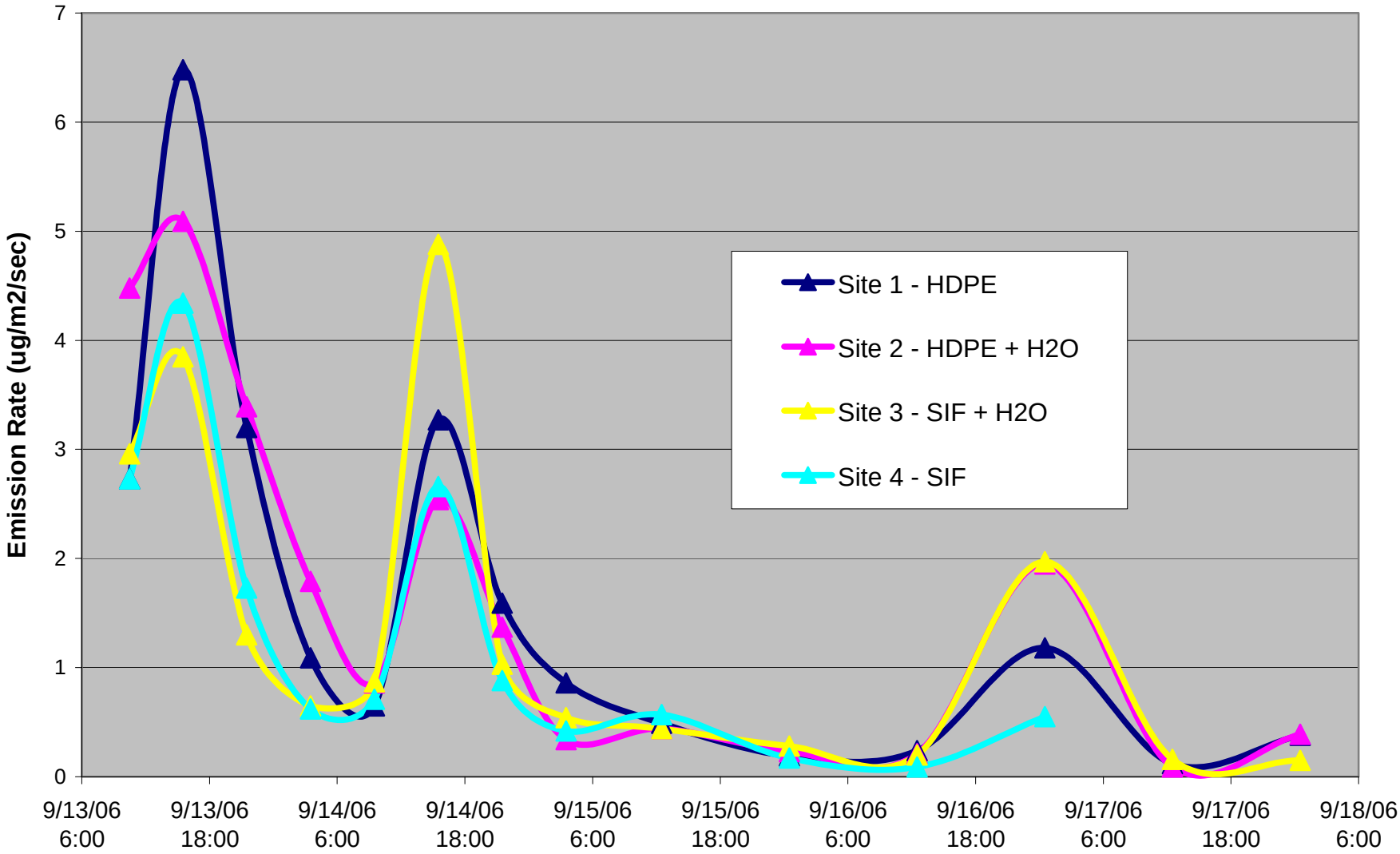


- ISCST Monitoring Station
- ISCST Weather Station
- Aerodynamic Weather Station
- Aerodynamic Monitoring Station
- Flux Chambers

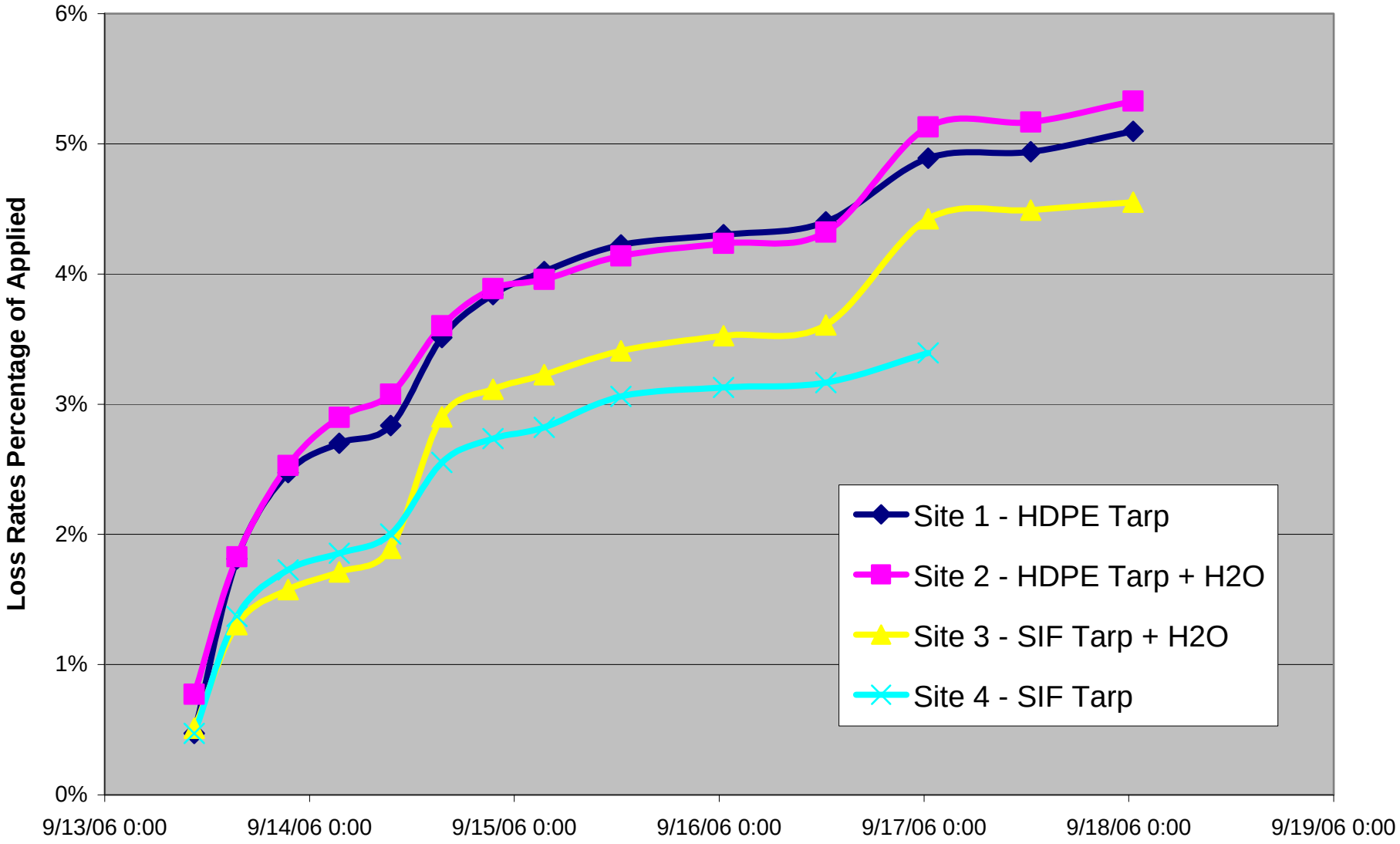

Estimated 1,3-D Emission Rates for the Four Fields in Oxnard
Emission Rate (ug/m2/sec)
45
40
35
30
25
20
15
10
5
0
9/13/06 0:00
9/14/06 0:00
9/15/06 0:00
9/16/06 0:00
9/17/06 0:00
9/18/06 0:00
9/19/06 0:00
9/20/06 0:00
9/21/06 0:00
Site 1 - HDPE Tarp
Site 2 - HDPE + H2O
Site 3 - SIF + H2O
Site 4 - SIF


Cumulative Percentage of 1,3-D Lost Relative to the Amount Applied
Loss Rates Percentage
35%
30%
25%
20%
15%
10%
5%
0%
9/13/06 0:00
9/14/06 0:00
9/15/06 0:00
9/16/06 0:00
9/17/06 0:00
9/18/06 0:00
9/19/06 0:00
9/20/06 0:00
9/21/06 0:00

Oxnard Off-Field Estimated Chloropicrin Emission Rates for the Four Fields



Cumulative Percentage of Chloropicrin Lost Relative to the Amount Applied



SIF SUMMARY

- 2.0 mil SIF reduced early emissions rate by 20% relative to 1.5 mil standard tarp.
- K-thiosulafte water seal reduced emissions by ~35%.
- 1,3-D (Telone) cumulative emissions from fields covered with SIF was ~83% relative to fields covered with 1.5 mil standard tarp.

- Earlier studies found that 1,3-D (Telone) cumulative emissions from the SIF field was ~50% relative to emissions from fields covered with 1.25 mil HDPE tarp.

Acknowledgments

- California Strawberry Commission
- California EPA-DPR
- Mandalay Berry Farms
- TriCal, Inc.
- Arysta LifeSciences
- Dow AgroSciences
- PolyPak America
- Bruno Rimini, Ltd.
- Tessenderlo Kerley, Inc.
- John Dullam
- Greg France
- Maria Vidauri
- Stuart Yamamoto
- Juan Hernandez
- Riccardo Rimini
- Juan Perez
- Jonathan Hunzie
- Matthew Linder
- Stan Young

Research was funded by the California Strawberry Commission

Thank you very much

Husein Ajwa

CE Specialist, UC Davis

1636 East Alisal Street, Salinas, CA 93905

Phone (831) 755-2823

FAX (831) 755-2844

haajwa@ucdavis.edu